Stone Moroko (*Pseudorasbora parva*)
Ecological Risk Screening Summary

Web Version – September 2014


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1 Native Range, and Status in the United States

Native Range
From Panov (2006):

"East Asian region including the basins of the rivers Amur, Yang-tze, Huang-ho, Japanese islands, western and southern parts of the Korean Peninsula and Taiwan."

Status in the United States
P. parva is not documented as either introduced or established anywhere in the United States (including territories).

Means of Introduction to the United States
P. parva is not documented as either introduced or established anywhere in the United States (including territories).

Remarks

From Witkowski (2006):

"The species owes its rapid expansion mainly to its small body size and physiological requirements (i.e., high oxygen, temperature range of oxygen), mode of life (hiding in densely vegetated parts of water bodies), and multi-litter spawning and parental care. Apart from this, its expansion is favored by human activities – stocking open waters and water bodies subject to intense fish farming. Its spread is also aided by anglers, since it is often used as bait. From places it invaded as a result of unintentional introduction (fish ponds), it rapidly spreads into lakes and river systems (Błachuta et al. 1993 [cited by Witkowski (2006) but not accessed for this report])."

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From ITIS (2012):

"Kingdom Animalia -- Animal
Phylum Chordata -- Chordates
Subphylum Vertebrata -- Vertebrates
Superclass Osteichthyes -- Bony fishes
Class Actinopterygii -- Ray-finned fishes, spiny rayed fishes
Subclass Neopterygii -- Neopterygians
Infraclass Teleostei
Superorder Ostariophysi
Order Cypriniformes -- Minnows, suckers
Superfamily Cyprinoidea
Family Cyprinidae -- Carps and minnows
Genus Pseudorasbora Bleeker, 1860
Species Pseudorasbora parva (Temminck and Schlegel, 1846)

Current Taxonomic standing: valid"

Size, Weight, Age

From Froese and Pauly (2010):

"Max length: 11.0 cm TL male/unsexed; (Berg 1964 [cited by Froese and Pauly (2010) but not accessed for this report]); common length : 8.0 cm TL male/unsexed; (Berg 1964 [cited by Froese and Pauly (2010) but not accessed for this report]); max. reported age: 5 years (Novikov et al. 2002 [cited by Froese and Pauly (2010) but not accessed for this report]) Length at first maturity: Lm 3.0 range ? - ? cm."

Environment
From Froese and Pauly (2010):

“Benthopelagic; freshwater; pH range: ? - 7.0; pH range: ? – 15”

Climate/Range
From Froese and Pauly (2010):

“Temperate: 5°C - 22°C (Baensch et al. 1985 [cited by Froese and Pauly (2010) but not accessed for this report]). Geographic range: 54°N - 22°N, 110°E - 141°E.”

Distribution Outside the United States
From Froese and Pauly (2010):

“Asia: Amur to Zhujiang [Pearl River] drainages in Siberia, Korea and China (Kottelat and Freyhof 2007 [cited by Froese and Pauly (2010) but not accessed for this report]). Introduced into various areas in Europe and Asia. Several countries report adverse ecological impact after introduction (Welcomme 1988 [cited by Froese and Pauly (2010) but not accessed for this report]).”

From: Panov (2006):

“In Europe, it was first recorded in 1961 from southern Romania and Albania. In 1972 the species was recorded from the European part of the former USSR – the Danube delta and Dniester. In slightly over 40 years it has almost entirely colonized Europe, proceeding rapidly from east to west, including Hungary, Czechoslovakia, France, Austria, Germany, Belgium, the Netherlands, Bulgaria, northern Greece, Turkey and the western part of the Balkans, Poland, Italy, England and Denmark.”

Means of Introduction Outside the United States
From Panov (2006):

“Accidental introduction or natural expansion of the range through river systems and it has been intentionally introduced through aquaculture. It was introduced in Europe unintentionally as a hitchhiker along with fishes (*Ctenopharyngodon idella*, *Aristichthys [Hypophathalmichthys] nobilis, Hypophathalmichthys molitrix*) imported from China.”

Short description
From Froese and Pauly (2010):

“Dorsal spines (total) 3; Dorsal soft rays (total) 7; Anal spines 3; Anal soft rays 6. Mouth superior and transverse; 6 branched anal rays; barbels absent; distal margin of dorsal convex;

large adults with sexually dimorphic coloration (Kottelat 2001 [cited by Froese and Pauly (2010) but not accessed for this report]).”

Biology

From Froese and Pauly (2010):

“Found in a wide variety of habitats, most abundantly in well vegetated small channels, ponds and small lakes (Kottelat and Freyhof 2007 [cited by Froese and Pauly (2010) but not accessed for this report]). Adults occur in cool running water. Feed on small insects, fish and fish eggs (Billard 1997 [cited by Froese and Pauly (2010) but not accessed for this report]), and plant material (Kottelat and Freyhof 2007 [cited by Froese and Pauly (2010) but not accessed for this report]). Usually breed in habitats with still or very slow-flowing water (Kottelat and Freyhof 2007 [cited by Froese and Pauly (2010) but not accessed for this report]).”

Human uses

From Froese and Pauly (2010):

“Fisheries: of no interest; aquarium ornamental pet; commercial.”

Diseases

From Panov (2006):

“*Spherotecum destruens*”

Threat to humans

From Froese and Pauly (2010):

“Potential pest.”

3 Impacts of Introductions

From Witkowski (2006):

“Where it occurs in high densities in fish ponds, it competes for food with farmed fish species (Kozlov 1974, Movčan and Smirnov 1981 [cited by Witkowski (2006) but not accessed for this report]). Most importantly it consumes larger species of planktonic crustaceans which results in an increase in the quantity of phytoplankton, and in increasing eutrophication of water bodies (Adamek and Sukop 2000 [cited by Witkowski (2006) but not accessed for this report]). [Note: Advanced eutrophication typically promotes excessive growth of algae. As the algae die and decompose, water is depleted of available oxygen. That causes the death of other organisms, such as fish.] *P. parva* feeds on juvenile stages of many locally valuable native fish species (Žitnan and Holčik 1976 [cited by Witkowski (2006) but not accessed for this report]). Being a vector of infectious fish diseases (among others *Spherotecum destruens*), it constitutes a serious threat to both native and farmed fishes in Europe (Gozlan et al. 2005)."

"In open waters of southern Europe, *P. parva* has probably contributed to a decrease in abundance and even disappearance of some autochthonous cyprinids (i.e., *Scardinius erythrophthalmus, Carassius carassius, Rhodeus sericeus, Gobio gobio, Leucaspius delineatus*) (Giurca and Angelescu 1971, Žitnan and Holčik 1976 [cited by Witkowski (2006) but not accessed for this report]). According to Bănărescu (1999 [cited by Witkowski (2006) but not accessed for this report]) and Rosecchi et al. (1993 [cited by Witkowski (2006) but not accessed for this report]), the species has probably modified the structure of the native communities of aquatic invertebrates in rivers. In ponds, high densities of *P. parva* deplete available food of farmed species (carp), and decreases cultured fish yields (Adamek and Sukop 2000 [cited by Witkowski (2006) but not accessed for this report])."

- "Competes for food with farmed fish species
- Indirectly increases the quantity of phytoplankton, and furthers eutrophication
- Feeds on juvenile stages of many locally valuable native fish species
- Is a vector of infectious diseases
- Contributed to a decrease in abundance and even localized extinctions of some autochthonous cyprinids
- Probably modified the structure of the native communities of aquatic invertebrates"

From Gozlan et al. (2005):

"The deliberate introduction of new species can have unexpected negative consequences and we show here how a recently introduced fish, the invasive Asian cyprinid *Pseudorasbora parva*, is causing increased mortality and totally inhibiting spawning in an already endangered native fish, the European cyprinid *Leucaspius delineatus*. This threat is caused by an infectious pathogen, a rosette-like intracellular eukaryotic parasite that is a deadly, nonspecific agent. It is probably carried by healthy Asian fish, and could decrease fish biodiversity in Europe, as well as having implications for commercial aquaculture…."

"By contrast, since its introduction in 1960 into Romanian ponds near the River Danube, the Asian topmouth gudgeon [also known as stone moroko], *P. parva*, has spread rapidly throughout Europe and has locally coincided with L. delineates extinction. In laboratory experiments (for methods, see supplementary information), we found that the holding water of *P. parva* acted as an absolute inhibitor of spawning for *L. delineatus* (no eggs produced in *P. parva* water compared with 1,596 $\pm$ 840 in control, clean water), and caused a large increase in fish mortality (69 $\pm$ 3% deaths in the treatment group, compared with 16 $\pm$ 2%; $P<0.05$, Mann-Whitney U-test; 4 experiments). These results were confirmed in a large natural outdoor pond, where *L. delineatus* populations declined by 96% over three spawning seasons (2002–04) after being mixed with *P. parva*, despite an increase of 13% in the year before *P. parva* arrived (2001). Spawning was totally inhibited in *L. delineatus* after *P. parva* was introduced. We found that the decline in *L. delineatus* (caused by total inhibition of spawning, loss of body condition, and death) that resulted from sharing water with *P. parva* was caused by an infectious organism.

Histological findings from moribund *L. delineatus* indicated extensive infection of visceral organs, including the reproductive tissues, with an obligate intracellular eukaryotic pathogen similar to the lethal rosette agent *Sphaerothecum destruens* that infects Chinook salmon, *Oncorhynchus tshawytscha*, and Atlantic salmon, *Salmo salar*…"

"Preliminary examination indicates that other cyprinids, such as the fathead minnow *Pimephales promelas*, are also susceptible to this pathogen, which causes effects identical to those in *L. delineatus* (prevalence, 20%; n=5). All *P. parva* specimens (n=10) tested for the rosette-like agent were negative: however, this is to be expected, given that pathogen concentrations in healthy carrier fish are very low and difficult to detect using conventional diagnostic tests. Cohabitation studies are a recognized method for detecting carrier states for different fish pathogens and, as our results illustrate, they are currently the most reliable way to detect a healthy carrier. Our results have three important implications. First, the most invasive fish species in Europe is a healthy host for a deadly, nonspecific pathogen that could threaten aquaculture trade, including that of salmonids. Second, it is difficult to identify fish populations that are carriers of pathogens. Third, this pathogen could pose a threat to the conservation of European fish diversity."

From Siriwardena (2011)

"**Impact Summary**

<u>Category</u>	<u>Impact</u>
Biodiversity (generally)	Negative
Native fauna	Negative"

"**Impact: Environmental**

<u>Impact on Biodiversity</u>

It is reported that the introduction of P. parva has negatively impacted upon the diversity of species in Puntee Alberete wetland in Italy (SEHUMED, 2000 [cited by Siriwardena (2011) but not accessed for this report]). P. parva, which has been introduced accidentally into freshwater ecosystems in China, not only has little commercial value but has made three species of Schizothoracine fishes endangered to near extinction (Liang, personal communication as stated in Ping and Yiyu, 2004 [no further information provided by Siriwardena (2011)]). In Tashkent in the former USSR, a number of fishes including P. parva, which were accidentally introduced, together with Ctenopharyngodon idella resulted in declines in local species through superior growth and fecundity (Rosenthal, 1976 as stated in FAO, 2004 [cited by Siriwardena (2011) but not accessed for this report]). P. parva is known to host non-native diseases of threat to native species (Cesco et al., 2001 [cited by Siriwardena (2011) but not accessed for this report]), including the rosette agent (Gozlan et al., 2005, 2006 [cited by Siriwardena (2011) but not accessed for this report])."

"Owing to its potential threat to aquatic biodiversity, P. parva has been listed under the species of fish whose keeping or release in any part of England and Wales is prohibited except under the authority of a license (Defra, 2004 [cited by Siriwardena (2011) but not accessed for this report])."

"**Risk and Impact Factors**
Invasiveness
Benefits from human association (i.e. it is a human commensal)
Capable of securing and ingesting a wide range of food
Fast growing
Gregarious
Has a broad native range
Has high genetic variability
Has high reproductive potential
Highly adaptable to different environments
Highly mobile locally
Is a habitat generalist
Pioneering in disturbed areas
Proved invasive outside its native range
Tolerant of shade
Tolerates, or benefits from, cultivation, browsing pressure, mutilation, fire etc."

"Impact outcomes
Altered trophic level
Changed gene pool/ selective loss of genotypes
Conflict
Damaged ecosystem services
Ecosystem change/ habitat alteration
Host damage
Negatively impacts aquaculture/fisheries
Negatively impacts cultural/traditional practices
Reduced amenity values
Reduced native biodiversity
Threat to/ loss of endangered species
Threat to/ loss of native species"

"Impact mechanisms
Competition - monopolizing resources
Competition - other
Fouling
Parasitism (incl. parasitoid)
Pathogenic
Pest and disease transmission
Predation
Rapid growth"

"Likelihood of entry/control
Difficult to identify/detect as a commodity contaminant
Difficult to identify/detect in the field

Difficult/costly to control
Highly likely to be transported internationally accidentally
Highly likely to be transported internationally deliberately
Highly likely to be transported internationally illegally"

4 Global Distribution

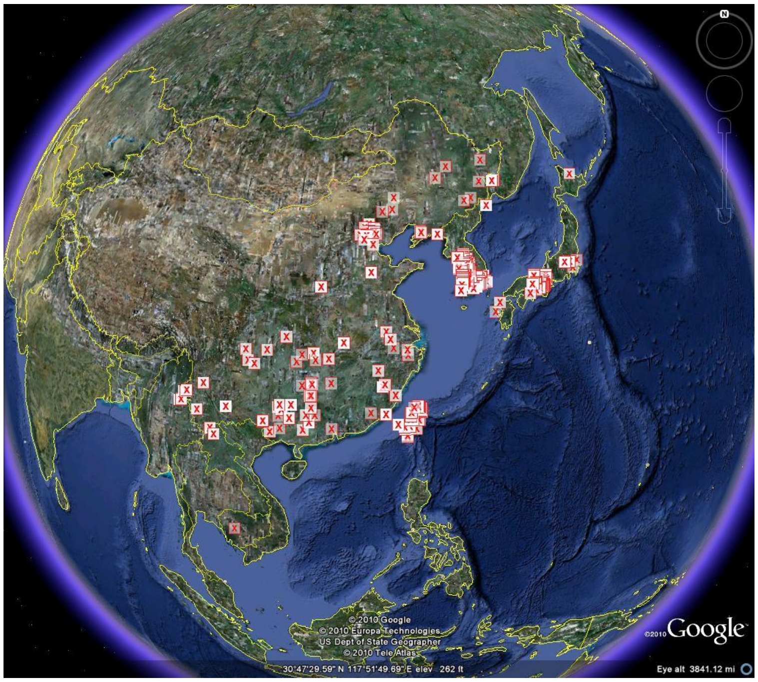

Figure 1. Some of the global distribution of *P. parva* from Froese and Pauly (2010). Map from Google Earth (2011).

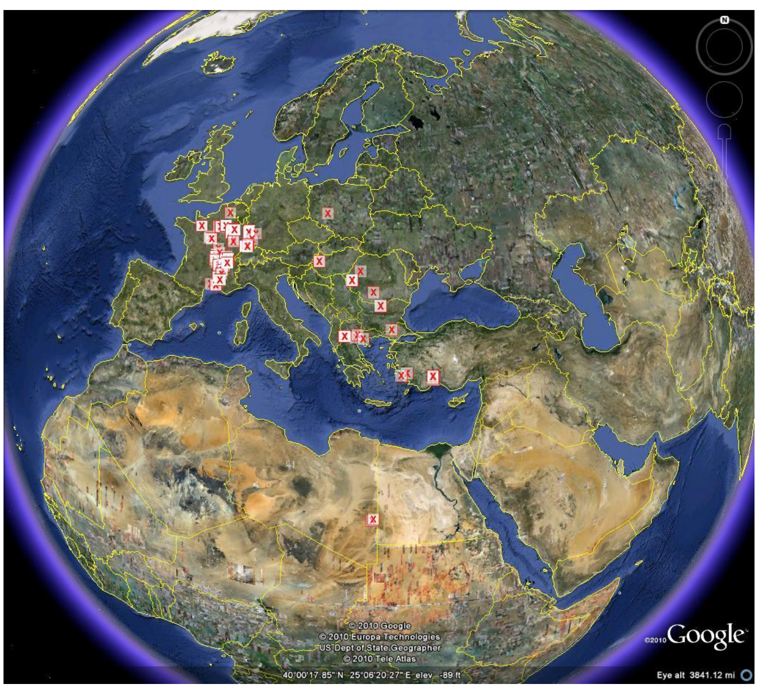

Figure 2. Some of the global distribution of *P. parva* Froese and Pauly (2010). Map from Google Earth (2011).

5 Distribution in the United States

No known US locations.

6 CLIMATCH

Summary of Climate Matching Analysis

The climate match (Australian Bureau of Rural Sciences (2010) 16 climate variables; Euclidean Distance) was high in most of the country. Very high matches were found along the southern Atlantic Coast, throughout Florida, the Great Lakes region, the central and southern plains states, the desert southwest, and northern California and Oregon. Climate 6 match indicated that the continental United States has a very high climate match. The range for high climate match is 0.103 and greater, climate match of the stone moroko is very high at 0.791.

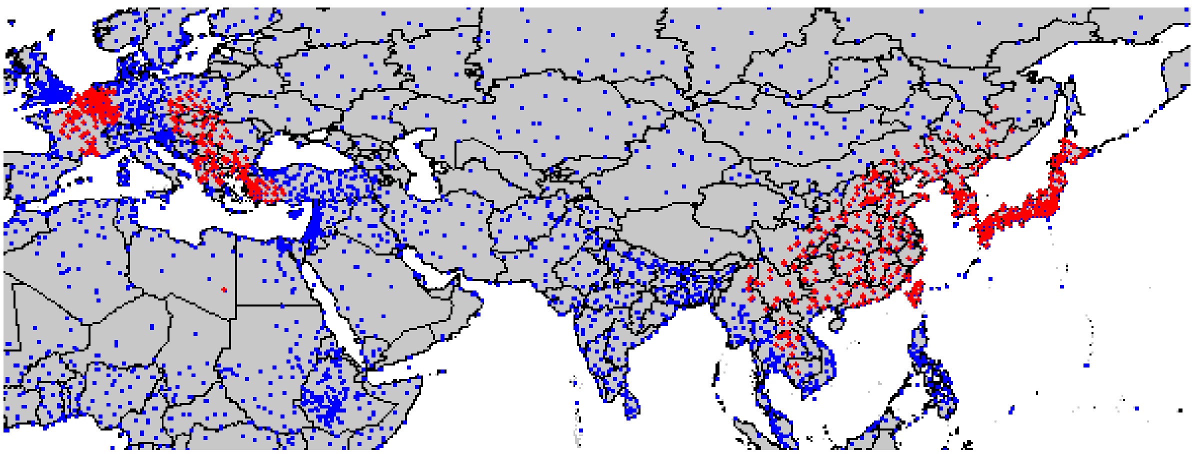

Figure 3. CLIMATCH (Australian Bureau of Rural Sciences 2010) source map showing weather stations selected as source locations (red) and non-source locations (blue) for *P. parva* climate matching. Source locations from Froese and Pauly (2010).

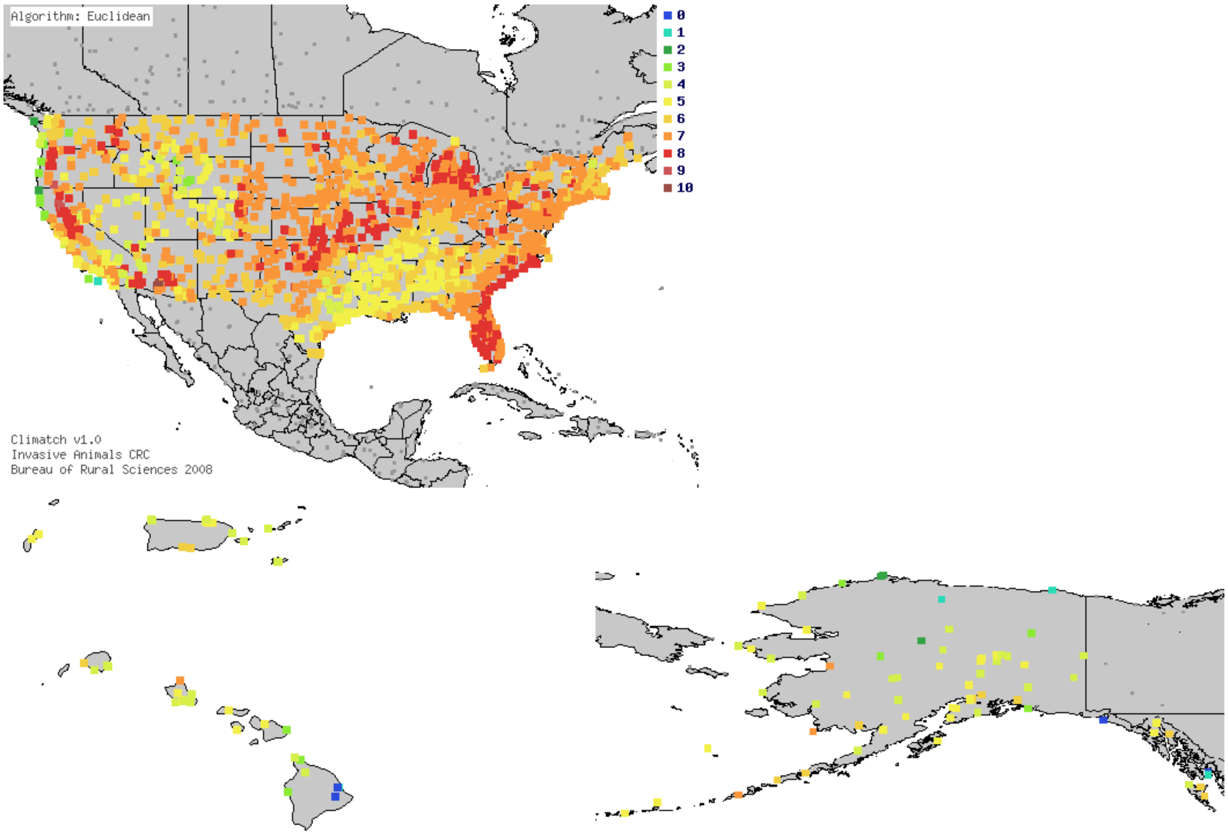

Figure 5. Map of CLIMATCH (Australian Bureau of Rural Sciences 2010) climate matches for *P. parva* in the continental United States, Alaska, Hawaii, Guam, Puerto Rico, and the US Virgin Islands based on source locations reported by Froese and Pauly (2010). 0= Lowest match, 10=Highest match.

Table 1. CLIMATCH climate match scores

CLIMATCH Score	0	1	2	3	4	5	6	7	8	9	10
Count	5	5	8	24	94	305	510	868	279	5	3
Climate 6 Proportion =			0.791	(High)							

7 Certainty of Assessment

Information on the biology, invasion history, and impacts of this species is sufficient to give an accurate description of the risk posed by this species. Certainty of this assessment is high.

8 Risk Assessment

Summary of Current U.S. Status and Projected Impacts of Introduction

Establishment and impacts are documented in Europe. Clear risk of introductions, establishment, and impacts in any areas of the United States, where climate match is moderate-high, that imports live fish from Europe or Asia. The species was inadvertently and purposefully introduced, and then spread on its own, into various portions of Europe. This species has been mixed with shipments of other species in Europe, and then release of fishes in those shipments has been attributed as resulting in establishment and impacts. Strategic steps should be undertaken to ensure that the species is not introduced into the waters of the Continental United States and Alaska.

In Europe, *P. parva*: competes for food with farmed fish species, feeds on juvenile stages of many locally valuable native fish species, is a vector of infectious diseases (including *Spherotecum destruens* [Note: I can find no documentation of this disease in the U.S. We will need to work with Fish Health/Fish Tech Center folks to discuss any documentation of this disease in the U.S.]) that constitutes a serious threat to both native and farmed fishes. From a disease perspective, the following text (Gozlan et al. 2005) documents some of the disease risks: "Our results have three important implications. First, the most invasive fish species in Europe is a healthy host for a deadly, nonspecific pathogen that could threaten aquaculture trade, including that of salmonids. Second, it is difficult to identify fish populations that are carriers of pathogens. Third, this pathogen could pose a threat to the conservation of European fish diversity."

Given the numerous reports on the invasive ability and impacts of this fish species, as well as the very high climate match in the continental United States and portions of Alaska, this is a species that carries a very high risk of impacts to wildlife resources of the United States. Twenty-five salmonid taxonomic units (i.e., species, ecologically significant units, or distinct population segments) are listed, under federal law, as threatened or endangered, and seven taxonomic units are species of concern. Most of these inhabit, during at least portions of their lives, areas that have high or medium climate matches for *P. parva*. Due to the already slim margin by which these species survive, and invasion by *P. parva* could have a significant impact. Additionally, the economic benefits provided by salmonid species that are not endangered or threatened could be greatly impacted by *P. parva*. Other species, including cyprinids are at risk to be significantly impacted, as has been documented in Europe. Both directly affected through disease transmission and indirectly by the removal of prey species (especially Cyprinids) or habitat alteration.

Assessment Elements

- **History of Invasiveness (See Section 3):** High
- **Climate Match (See Section 6):** High
- **Certainty of Assessment (See Section 7):** High
- **Overall Risk Assessment Category: High**

The following table includes a brief description of projected impacts to wildlife resources of the United States.

Table. Generalized, projected impacts of *P. parva* on wildlife resources of the United States. The climate match is high between the native/established ranges of *P. parva* and that of the United States. Specifically, the match is high with most of the Continental United States and portions of southeast and southern Alaska. Therefore, details of impacts are too numerous to list in this screening report. Specific details of impacts will depend on local ecological structure (i.e., fish species composition, population abundance, and community structure; zooplankton biomass and community structure; and habitat variables including areas where water quality is already degraded as the result of other impacts).

Threat	Projected Level of Impact to Wildlife Resources of the U.S.	Description of Impact	Projections of impacts to Wildlife Resources of the U.S.
Habitat Degradation	Moderate	*P. parva* consumes larger species of planktonic crustaceans, and that results in an increase in the quantity of phytoplankton and further eutrophication of water bodies (Adamek and Sukop 2000).	These impacts are projected to be greatest in shallow lakes; large bays, tributaries, and nearshore areas within the Great Lakes basin; reservoirs; and lowland rivers.
Species Extirpation/Extinction	High	*P. parva*: feeds on juveniles of native species; outcompetes native cyprinids; as a disease vector, can infect stocks of native fishes, which results in rapidly depleting numbers (Žitnan and Holčik 1976, Golzan et al. 2005).	Predation impacts of *P. parva* will be most significant on juveniles of imperiled fishes. That predation pressure will be greatest where *P. parva* is projected to become most abundant--in slower moving reaches of larger rivers, smaller tributary reaches of rivers, lakes (including nearshore, shallow portions of the Great Lakes), and portions of reservoirs. Competition with native cyprinids will be greatest in

			slower moving reaches of larger rivers, smaller tributary reaches of rivers, lakes (including portions of the Great Lakes), and portions of reservoirs. Cyprinids at greatest risk will include those presently imperiled (including and especially Threatened and Endangered cyprinids). The impacts of disease transmitted by *P. parva* will be greatest in locations where cyprinids and salmonids cohabit with *P. parva*. Projection of habitat overlap will be greatest with that of cyprinids, so *P. parva* is projected to more frequently transmit disease to cyprinids, which may then transmit disease to salmonids in larger, faster flowing portions of river systems not frequently inhabited by *P. parva*. The result is projected to be the same—infection of at least cyprinids and salmonids in waters where *P. parva* becomes established. Habitats where cyprinids, salmonids, and *P. parva* will cohabit, at least during portions of salmonid life cycles, likely include slower moving reaches of larger rivers, smaller tributary reaches of rivers, lakes (including portions of the Great Lakes), and reservoirs. However, many cyprinids will overlap habitats with *P. parva* frequently and consistently. Concern is herein registered about possible disease transmission that could eventually affect coregonids (species in the salmonid family). Coregonids include ecologically and economically important species such as the lake whitefish

			(*Coregonus clupeaformis*), cisco (*C. artedi*), and the imperiled shortjaw cisco (*C. zenithicus*).
Food Web Disruption	Moderate	*P. parva* indirectly increases the quantity of phytoplankton, feeds on juvenile stages of many locally valuable native fish species (Adamek and Sukop 2000).	Zooplankton are important foods of almost all fishes during at least the larval stage. For many fishes, such as paddlefish (*Polyodon spathula*) and many cyprinids, zooplankton is an important food throughout life. Thus, reduced growth and recruitment of native fishes, and particularly during larval stages critical to recruitment success (and sustaining populations), is projected to result where *P. parva* becomes highly abundant. These impacts are projected to be greatest in lakes (including portions of the Great Lakes such as bays and nearshore areas that are important nursery habitats for many fishes), reservoirs, slower moving portions of large rivers, and small tributaries to those rivers.
Degradation of Fish Stocks	High	*P. parva*: feeds on juveniles of native species; outcompetes native cyprinids; as a disease vector, can infect large stocks of native fishes, which results in rapidly depleting numbers (Žitnan and Holčik 1976, Golzan et al. 2005).	See projected impacts to U.S. wildlife resources listed in Species Extirpation/Extinction above.
Competition	Moderate	*P. parva* outcompetes native cyprinids (Žitnan	Zooplankton are important foods of almost all native cyprinids during at least the larval stage.

		and Holčik 1976).	Thus, reduced growth and recruitment of native cyprinids, and particularly larval stages critical to recruitment success (and sustaining populations) is projected to result where *P. parva* becomes highly abundant. Competition will most impact imperiled fishes, and is projected to be greatest in lakes (including portions of the Great Lakes such as bays and nearshore areas), reservoirs, slower moving portions of large rivers, and small tributaries to those rivers.
Predation	Moderate	*P. parva* feeds on juveniles of native species (Žitnan and Holčik 1976).	Habitats where risk of predation by *P. parva* is projected to be greatest include slower moving reaches of larger rivers, smaller tributary reaches of rivers, lakes, and reservoirs. Impacts may be greatest on imperiled species, but populations of many ecologically important species, which are presently abundant, are projected to decrease where *P. parva* becomes abundant.
Reproductive Interference	High	Disease carried by *P. parva* causes fish without immunity to become unable to reproduce, drastically reducing production of future stocks (Golzan et al. 2005).	These impacts of transmitted disease will be greatest in locations where both cyprinids and salmonids cohabit with *P. parva*. However, it is projected that habitat overlap of *P. parva* with cyprinids will be greater than that overlap of *P. parva* with salmonids. Therefore, *P. parva* may transmit disease, at greatest rates, directly to cyprinids, and then indirectly (via cyprinids) to salmonids. Habitats where cyprinids, salmonids, and *P. parva* will overlap is projected to include slower moving reaches of larger rivers, smaller tributary reaches of rivers, lakes (including

			portions of the Great Lakes and its tributaries and estuaries), and reservoirs.

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